ENVIRONMENTAL MONITORING PROGRAM INFORMATION

Introduction

The high-level radioactive waste (HLW) presently stored at the West Valley Demonstration Project (the WVDP or Project) is the byproduct of the reprocessing of spent nuclear fuel conducted during the late 1960s and early 1970s by Nuclear Fuel Services, Inc. (NFS).

Since the Western New York Nuclear Service Center (WNYNSC) is no longer an active nuclear fuel reprocessing facility, the environmental monitoring program focuses on measuring radioactivity and chemicals associated with the residual effects of NFS operations and the Project's high-level waste treatment and low-level waste management operations.

The following information about the operations at the WVDP and about radiation and radioactivity will be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

Radiation and Radioactivity

Radioactivity is a process in which unstable atomic nuclei spontaneously disintegrate or "decay" into atomic nuclei of another isotope or element. (See p. 5 in the *Glossary*.) The nuclei continue to decay until only a stable, nonradioactive isotope remains. Depending on the isotope, this process can take anywhere from less than a second to hundreds of thousands of years.

As atomic nuclei decay, *radiation* is released in three main forms: alpha particles, beta particles, and gamma rays. By emitting energy or particles, the nucleus moves toward a less energetic, more stable state.

Alpha Particles

An alpha particle, released by decay, is a fragment of a much larger nucleus. It consists of two protons and two neutrons (similar to a helium atom nucleus) and is positively charged. Compared to beta particles, alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation, therefore, is easily stopped by a thin layer of material such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues because all of their energy is absorbed by tissue cells in the immediate vicinity of the decay. An example of an alpha-emitting radionuclide is the uranium isotope with an atomic weight of 232 (uranium-232). At the WVDP, uranium-232 is in the high-level waste mixture and can be detected

Ionizing Radiation

Radiation can be damaging if, in colliding with other matter, the alpha or beta particles or gamma rays knock electrons loose from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes an electrically neutral atom, in which the positively charged protons and the negatively charged electrons balance each other, into a charged atom called an ion. An ion can be either positively or negatively charged. Various kinds of ionizing radiation produce different degrees of damage.

in liquid waste streams as a result of a thorium-based nuclear fuel reprocessing campaign conducted by NFS.

Beta Particles

A beta particle is an electron that results from the breakdown of a neutron in a radioactive nucleus. Beta particles are small compared to alpha particles, travel at a higher speed (close to the speed of light), and can be stopped by a material such as wood or aluminum less than an inch thick. If beta particles are released inside the body they do much less damage than an equal number of alpha particles. Because they are smaller and faster and have less of a charge, beta particles deposit energy in fewer tissue cells and over a larger volume than alpha particles. Strontium-90, a fission product (see *Glossary*, p. 4), is an example of a beta-emitting radionuclide. Strontium-90 is found in the decontaminated supernatant.

Gamma Rays

Gamma rays are high-energy "packets" of electromagnetic radiation, called photons, that are emitted from the nucleus. They are similar to x-rays but generally have a shorter wavelength and therefore are more energetic than x-rays. If the alpha or beta particle released by the decaying nucleus does not carry off all the energy generated by the nuclear disintegration, the excess energy may be emitted as gamma rays. If the released energy is high, a very penetrating gamma ray is produced that can be effectively reduced only by shielding consisting of several inches of a heavy element, such as lead, or of water or concrete several feet thick. Although large amounts of gamma radiation are dangerous, gamma rays are also used in many lifesaving medical procedures. An example of a gamma-emitting radionuclide is barium-137m, a short-lived daughter product of cesium-137. Both barium-137m and cesium-137 are major constituents of the WVDP high-level radioactive waste.

Measurement of Radioactivity

The rate at which radiation is emitted from a disintegrating nucleus can be described by the number of decay events or nuclear transformations that occur in a radioactive material over a fixed period of time. This process of emitting energy, or radioactivity, is measured in curies (Ci) or becquerels (Bq).

The curie is based on the decay rate of the radionuclide radium-226 (Ra-226). One gram of Ra-226 decays at the rate of 37 billion nuclear disintegrations per second (3.7×10^{10} d/s), so one curie equals 37 billion nuclear disintegrations per second. One becquerel equals one decay, or disintegration, per second.

Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. Somatic effects are restricted to the person who has been exposed to radiation. For example, sufficiently high exposure to radiation can cause clouding of the lens of the eye or loss of white blood cells.

Radiation also can cause chromosomes to break or rearrange themselves or to join incorrectly with other chromosomes. These changes may produce genetic effects and may show up in future generations. Radiation-produced genetic defects and mutations in the offspring of an exposed parent, while not positively identified in humans, have been observed in some animal studies.

The effect of radiation depends on the amount absorbed within a given exposure time. The only observable effect of an instantaneous whole-body dose of 50 rem (0.5 Sv) might be a temporary reduction in white blood cell count. An instantaneous dose of 100-200 rem (1-2 Sv) might cause additional temporary effects such as vomiting but usually would have no long-lasting side effects.

Assessing biological damage from low-level radiation is difficult because other factors can cause the same symptoms as radiation exposure. Moreover, the body apparently is able to repair damage caused by low-level radiation.

The effect most often associated with exposure to relatively high levels of radiation appears to be an increased risk of cancer. However, scientists have not been able to demonstrate with certainty that exposure to low-level radiation causes an increase in injurious biological effects, nor have they been able to determine if there is a level of radiation exposure below which there are no biological effects.

Background Radiation

Background radiation is always present, and everyone is constantly exposed to low levels of such radiation from both naturally occurring and manmade sources. In the United States the average total annual exposure to this low-level background radiation is estimated to be about 360 millirem (mrem) or 3.6 millisieverts (mSv). Most of this radiation, approximately 295 mrem (2.95 mSv), comes from natural sources. The rest comes from medical procedures, consumer products, and other manmade sources. *(See p. 4-3 in Chapter 4, Radiological Dose Assessment.)*

Background radiation includes cosmic rays, the decay of natural elements such as potassium, uranium, thorium, and radon, and radiation from sources such as chemical fertilizers, smoke detectors, and televisions. Actual doses vary depending on such factors as geographic location, building ventilation, and personal health and habits.

trillionth (10^{-12}) of a curie, equal to 3.7 x 10^{-2} disintegrations per second, or 2.22 disintegrations per minute.

Measurement of Dose

The amount of energy absorbed by the receiving material is measured in rads (radiation absorbed dose). A rad is 100 ergs of radiation energy absorbed per gram of material. (An erg is the amount of energy necessary to lift a mosquito about one-sixteenth of an inch.) "Dose" is a means of expressing the amount of energy absorbed, taking into account the effects of different kinds of radiation. Alpha, beta, and gamma radiation affect the body to different degrees. Each type of radiation is given a quality factor that indicates the extent of human cell damage it can cause compared with equal amounts of other ionizing radiation energy. Alpha particles cause twenty times as much damage to internal tissues as x-rays, so alpha radiation has a quality factor of 20 compared to gamma rays, x-rays, or beta particles, which have a quality factor of 1.

The unit of dose measurement to humans is the rem (roentgen-equivalent-man). Rems are equal to the number of rads multiplied by the quality factor for each type of radiation. Dose can also be expressed in sieverts. One sievert equals 100 rem.

Environmental Monitoring Program Overview

Human beings may be exposed to radioactivity primarily through air, water, and food. At the WVDP all three pathways are monitored, but air and surface water pathways are the two primary means by which radioactive material can move off-site.

The geology of the site (kinds and structures of rock and soil), the hydrology (location and flow of surface and underground water), and meteorological characteristics of the site (wind speed, patterns, and direction) are all considered in evaluating potential exposure through the major pathways.

The on-site and off-site monitoring program at the WVDP includes measuring the concentration of alpha and beta radioactivity, conventionally referred to as "gross alpha" and "gross beta," in air and water effluents. Measuring the total alpha and beta radioactivity from key locations, which can be done within a matter of hours, produces a comprehensive picture of on-site and off-site levels of radioactivity from all sources. In a facility such as the WVDP, frequent updating and tracking of the overall levels of radioactivity in effluents is an important tool in maintaining acceptable operations.

More detailed measurements are also made for specific radionuclides. Strontium-90 and cesium-137 are measured because they are normally present in WVDP waste streams. Radiation from other important radionuclides such as tritium or iodine-129 are not sufficiently energetic to be detected by gross measurement techniques, so these must be analyzed separately using methods with greater sensitivity. Heavy elements such as uranium, plutonium, and americium require special analysis to be measured because they exist in such small concentrations in the WVDP environs.

The radionuclides monitored at the Project are those that might produce relatively higher doses or that are most abundant in air and water effluents. Because manmade sources of radiation at the Project have been decaying for more than twenty years, the monitoring program does not routinely include short-lived radionuclides, i.e., isotopes with a half-life of less than two years, which would have only 1/1,000 of the original radioactivity remaining. (See *Appendix A* [pp.A-i through A-53] for the schedule of samples and radionuclides measured and *Appendix B*, Table B-1 [p. B-3] for related Department of Energy

Derived Concentration Guides

A derived concentration guide (DCG) is defined by the DOE as the concentration of a radionuclide in air or water that, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), for one year, would result in an effective dose equivalent of 100 mrem (1 mSv) to a "reference man." These concentrations — DCGs — are considered screening levels that enable site personnel to review effluent and environmental data and to decide if further investigation is needed. (See Table B-1, Appendix B, p. B-3 for a list of DCGs.)

DOE Orders require that the hypothetical dose to the public from facility effluents be estimated using specific computer codes. (See Dose Assessment Methodology [p. 4-6] in Chapter 4, Radiological Dose Assessment.) Doses estimated for WVDP activities are calculated using actual site data and are not related directly to DCG values.

Dose estimates are based on a sum of isotope quantities released and the dose equivalent effects for that isotope. For liquid effluent screening purposes, percentages of the DCGs for all radionuclides present are added: if the total percentage of the DCGs is less than 100, then the effluent released complies with the DOE guideline.

Although the DOE provides DCGs for airborne radionuclides, the more stringent U.S. Environmental Protection Agency (EPA) National Emissions Standards for Hazardous Air Pollutants (NESHAP) apply to Project airborne effluents. As a convenient reference point, comparisons with DCGs are made throughout this report for both air and water samples.

[DOE] protection standards, i.e., derived concentration guides [DCGs] and half-lives of radionuclides measured in WVDP samples.)

Data Reporting

Because the decay of radioactive atoms is a random process, there is an inherent uncertainty associated with all environmental radioactivity measurements. This can be demonstrated by repeatedly measuring the number of atoms that decay in a radioactive sample over some fixed period of time. The result of such an experiment would be a range of values for which the average value would provide the best indication of how many radioactive atoms were present in the sample.

However, in actual practice a sample of the environment usually is measured for radioactivity just once, not many times. The inherent uncertainty of the measurement, then, stems from the fact that it cannot be known whether the result that was obtained from one measurement is higher or lower than the "true" value, i.e., the average value that would be obtained if many measurements had been taken.

The term *confidence interval* is used to describe the range of measurement values above and below the test result within which the "true" value is expected to lie. This interval is derived mathematically. The width of the interval is based primarily on a predetermined *confidence level*, i.e., the probability that the *confidence interval* actually encompasses the "true" value (the average value that would be obtained if many measurements were taken). The WVDP environmental monitoring program uses a 95% *confidence level* for all radioactivity measurements and calculates *confidence intervals* accordingly.

The confidence interval around a measured value is indicated by the plus-or-minus (±) value following the result, e.g., 5.30 ± 3.6E-09μCi/mL, with the exponent of 10^{-9} expressed as "E-09." Expressed in decimal form, the number would be $0.0000000053 \pm 0.0000000036 \mu$Ci/mL. A sample measurement expressed this way is correctly interpreted to mean "there is a 95% probability that the concentration of radioactivity in this sample is between 1.7E-09μCi/mL and 8.9E-09μCi/mL."

If the confidence interval for the measured value includes zero (e.g., 5.30 $\pm$ 6.5E-09μCi/mL), the value is considered to be below the detection limit. The values listed in tables of radioactivity measurements in the appendices include the confidence interval regardless of the detection limit value.

In general, the detection limit is the minimum amount of constituent or material of interest detected by an instrument or method that can be distinguished from background and instrument noise. Thus, the detection limit is the lowest value at which a sample result shows a statistically positive difference from a sample in which no constituent is present.

Nonradiological data conventionally are presented without an associated uncertainty and are expressed by the detection limit prefaced by a "<" if that analyte was not measurable. (See also *Data Reporting* [p. 5-7] in ***Chapter 5, Quality Assurance***.)

1997 Changes in the Environmental Monitoring Program

Changes in the 1997 environmental monitoring program enhanced the environmental sampling and surveillance network in order to support current activities and to prepare for future activities.

- The vitrification heating, ventilation, and air conditioning (HVAC) stack monitoring and sampling systems were brought on-line in November 1995. The actual volumetric discharge rate was verified in February 1996. Final isokinetic sampling system specifications were prepared in February also, and the equipment was installed in March 1996. The vitrification system began radioactive operations with the first transfer of high-level waste in June 1996, followed by the start of vitrification in July 1996. In 1997 stack monitoring was improved by installing a heat trace along the monitoring line to prevent ice build-up.

- With the new meteorological tower fully operational, the previous tower was dismantled in July 1997.

- Stack monitoring at the CO_2 decontamination facility was discontinued after the facility was decontaminated and released.

- The groundwater monitoring program was reviewed, and in July three wells monitoring the underground fuel storage tank area were decommissioned. The sampling frequency and the analytes measured were further tailored to address site-wide monitoring parameters as well as constituents of concern specific to super solid waste management units (SSWMUs).

Appendix A (pp. A-i through A-53) summarizes the program changes and lists the sample points and parameters measured in 1997.

Vitrification Overview

High-level radioactive waste from NFS operations was originally stored in two of four underground tanks (tanks 8D-2 and 8D-4). The waste in 8D-2, the larger of the active tanks, had settled into two layers: a liquid — the supernatant — and a precipitate layer on the tank bottom — the sludge.

To solidify the high-level waste, WVDP engineers designed and developed a process of pretreatment and vitrification.

Pretreatment Accomplishments

The supernatant (in tank 8D-2) was composed mostly of sodium and potassium salts dissolved in water. Radioactive cesium in solution accounted for more than 99% of the total radioactivity in the supernatant. During pretreatment, sodium salts and sulfates were separated from the radioactive constituents in both the liquid portion of the high-level waste and the sludge layer in the bottom of the tank.

Pretreatment of the supernatant began in 1988. A four-part process, the integrated radwaste treatment system (IRTS), reduced the volume of the high-level waste needing vitrification by producing low-level waste stabilized in cement. The supernatant was passed through zeolite-filled ion exchange columns in the supernatant treatment system (STS) to remove more than 99.9% of the radioactive cesium. The resulting liquid was then concentrated by evaporation in the liquid waste treatment system (LWTS).

This low-level radioactive concentrate was blended with cement in the cement solidification system (CSS) and placed in 269-liter (71-gal) steel drums. This cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).

Finally, the steel drums were stored in an on-site aboveground vault, the drum cell. Processing of the supernatant was completed in 1990, with more than 10,000 drums of cemented waste produced.

The sludge that remained was composed mostly of iron hydroxide. Strontium-90 accounted for most of the radioactivity in the sludge. Pretreatment of the sludge layer in high-level waste tank 8D-2 began in 1991. Five specially designed 50-foot-long pumps were installed in the tank to mix the sludge layer with water in order to produce a uniform sludge blend and to dissolve the sodium salts and sulfates that would interfere with vitrification. After mixing and allowing the sludge to settle, processing of the wash water through the integrated radwaste treatment system began. Processing removed radioactive constituents for later solidification into glass, and the wash water containing salts was then stabilized in cement.

Sludge washing was completed in 1994 after approximately 765,000 gallons of wash water had been processed. About 8,000 drums of cement-stabilized wash water were produced.

In January 1995, high-level waste liquid stored in tank 8D-4 was transferred to tank 8D-2. (Tank 8D-4 contained THOREX high-level radioactive waste. This waste had been produced by a single reprocessing campaign of a special fuel containing thorium that had been conducted from November 1968 to January 1969 by the previous facility operators.) The resulting mixture was washed and the wash water was processed. The IRTS processing of the combined wash waters was completed in May 1995.

In all, through the supernatant treatment process and the sludge wash process, more than 1.7 million gallons of liquid had been processed by the end of 1995, producing a total of 19,877 drums of cemented low-level waste.

As one of the final steps, the ion-exchange material (zeolite) used in the integrated radwaste treatment system to remove radioactivity was blended with the washed sludge before being transferred to the vitrification facility for blending with the glass-formers. In 1995 and early 1996 final waste transfers to high-level waste tank 8D-2 were completed in preparation for vitrification.

Preparation for Vitrification

Nonradioactive testing of a full-scale vitrification system was conducted from 1984 to 1989. In 1990 all vitrification equipment was removed to allow installation of shield walls for fully remote radioactive operations. The walls and shielded tunnel connecting the vitrification facility to the former reprocessing plant were completed in 1991.

The slurry-fed ceramic melter was fully assembled, bricked, and installed in 1993. In addition, the cold chemical building was completed, as was the sludge mobilization system that transfers high-level waste to the melter. This system was fully tested in 1994. A number of additional major systems components also were installed in 1994: the canister turntable, which positions the stainless steel canisters as they are filled with molten glass; the submerged bed scrubber, which cleans gases produced by the vitrification process; and the transfer cart, which moves filled canisters to the storage area.

Nonradiological testing (“cold” operations) of the vitrification facility began in 1995, and the first canister of nonradiological glass was produced. The WVDP declared its readiness to proceed with the necessary equipment tie-ins of the ventilation and utility systems to the vitrification facility building and tie-ins of the transfer lines to and from the high-level waste tank farm and the vitrification facility. In this closed-loop system, the transfer lines connect to multiple common lines so that material can be moved among all the points in the system. High-level waste vitrification began in 1996.

1997 Activities at the WVDP

Vitrification

Solidification of the high-level waste in glass continued in 1997. The high-level waste mixture of washed sludge and spent zeolite from the ion-exchange process is combined in batches with glass-forming chemicals and then fed to a ceramic melter. The waste mixture is heated to approximately 2,000°F and poured into stainless steel canisters. Approximately 300 stainless steel canisters will be needed to hold all of the vitrified waste. Each canister, 10 feet long by 2 feet in diameter, is filled with a uniform, high-level waste glass that will be suitable for eventual shipment to a federal repository.

In 1997 a total of 119 high-level waste canisters were produced and more than 5.5 million curies of radioactivity were transferred to the vitrification facility. Since the beginning of vitrification in 1996, 178 high-level waste canisters have been filled. Based on analysis of the first forty-five batches, the total number of cesium/strontium curies transferred to the vitrification facility by the end of 1997 was more than 7.8 million.

Environmental Management

Aqueous Radioactive Waste

Water containing radioactive material from site process operations is collected and treated in the low-level liquid waste treatment facility (LLWTF). (Water from the sanitary system, which does not contain added radioactive material, is managed in a separate system.)

The treated process water is held, sampled, and analyzed before it is released through a State Pollutant Discharge Elimination System (SPDES)-permitted outfall. In 1997, 44.0 million liters (11.6 million gal) of water were treated in the LLWTF and discharged through outfall 001, the lagoon 3 weir.

The discharge waters contained an estimated 12 millicuries of gross alpha plus gross beta radioactivity. Comparable releases during the previous twelve years averaged about 41 millicuries per year. The 1997 release was about 29% of this average. (See *Radiological Monitoring, Low-level Waste Treatment Facility Sampling Location* [p. 2-2] in ***Chapter 2, Environmental Monitoring***.)

Approximately 0.45 curies of tritium were released in WVDP liquid effluents in 1997. This is 27% of the twelve-year average of 1.66 curies.

Unplanned Radiological Releases

A spill of radioactive material at the WVDP occurred on December 15, 1997 in the site's waste storage tank area. A 50-foot long pump in the main radioactive waste storage tank (tank 8D-2) was being remotely flushed and sparged with water and air by Project employees in order to wash contamination off the pump shaft and back into the waste tank in preparation for pump-removal and replacement.

As the flushing and sparging process was completed, a small amount of liquid began to drip from the valve handle area of an air regulator. Two employees' hands were contaminated when they closed the shutoff valve on the line and wiped some of the liquid from the control board. About 100 mL (one-half cup) of the liquid dripped onto the ground. The employees' hands were cleaned and decontaminated, and contaminated soil was dug up. The contaminated soil, control board, and other materials were packaged and placed in storage. The quantity of liquid released was very small and was limited to the immediate area of the waste tank farm, a controlled radiological buffer facility area.

This event was categorized as an off-normal occurrence and an Occurrence Report was prepared. A regulatory compliance evaluation determined that no radioactivity above reportable quantity thresholds was released to the environment.

One other spill in 1997 was observed in the waste tank farm when a pipe containing liquid from the pan under tank 8D-1 was found to be dripping. Pumping was immediately stopped and the leak investigated. A sample of the water was collected and analyzed for gross alpha and beta concentrations; no radioactivity was detected. The spill was not reportable, no cleanup was warranted, and no waste was generated.

There were no unplanned releases in 1997 from the Project to the off-site environment.

Airborne Radioactive Emissions

Ventilated air from the various points in the IRTS process (high-level waste sludge treatment, main plant and liquid waste treatment system, and the cement solidification system) and from other waste management activities is sampled continuously during operation for both particulate matter and for gaseous radioactivity. In addition to monitors that alarm if particulate matter radioactivity increases above preset levels, the sample media are analyzed in the laboratory for the specific radionuclides that are present in the radioactive materials being handled.

Air used to ventilate the facilities where radioactive material cleanup processes are operated is passed through filtration devices before being emitted to the atmosphere. These filtration devices are generally more effective for particulate matter than for gaseous radioactivity. For this reason, facility air emissions tend to contain a greater amount of gaseous radioactivity (e.g., tritium and iodine-129) than radioactivity associated with particulate matter (e.g., strontium-90 and cesium-137). However, gaseous radionuclide emissions still remain so far below the most restrictive regulatory limit for public safety that additional treatment technologies beyond that already provided by, for example, the vitrification off-gas treatment system, are not necessary.

Gaseous radioactivity emissions from the main plant in 1997 included approximately 140 millicuries of tritium (as hydrogen tritium oxide [HTO] and 7.43 millicuries of iodine-129. (See ***Chapter 2,*** p. 2-31, for further discussion of iodine-129 emissions from the main plant stack.) In 1996, a year in which the vitrification system was in operation for half of the year, tritium and iodine-129 emissions were 53 millicuries and 1.2 millicuries respectively.

Particulate matter radioactivity emissions from the main plant in 1997 included approximately 0.4 millicuries of beta-emitting radioactivity and 0.001 millicuries of alpha-emitting radioactivity. In 1996, beta-emitting and alpha-emitting radioactivity emissions were 0.1 millicuries and 0.0004 millicuries respectively.

NRC-licensed Disposal Area (NDA) Interceptor Trench and Pretreatment System

Radioactively contaminated n-dodecane in combination with tributyl phosphate (TBP) was discovered at the northern boundary of the NDA in 1983, shortly after the Department of Energy assumed control of the WVDP site. Extensive sampling and monitoring through 1989 revealed the possibility that the n-dodecane/TBP could migrate. To contain this subsurface organic contaminant migration, an interceptor trench and liquid pretreatment system (LPS) were built.

The trench was designed to intercept and collect subsurface water, which could be carrying n-dodecane/TBP, in order to prevent the material from entering the surface water drainage ditch leading into Erdman Brook. The LPS was installed to decant the n-dodecane/TBP from the water and to remove iodine-129 from the collected water before its transfer to the low-level waste treatment facility. The separated n-dodecane/TBP would be stored for subsequent treatment and disposal. As in previous years, no water containing n-dodecane/TBP was encountered in the trench and no water or n-dodecane/TBP was treated by the LPS in 1997.

Results of surface and groundwater monitoring in the vicinity of the trench are discussed under *NDA Sampling Locations*, p. 2-10, and *Results of Monitoring at the NDA*, p. 3-14, respectively.

Waste Minimization Program

The WVDP formalized a waste minimization program in 1991 to reduce the generation of low-level waste, mixed waste, and hazardous waste. Industrial waste and sanitary waste reduction goals were added in 1994. By using source reduction, recycling, and other techniques, waste in all of these categories has been greatly reduced. In 1997, the seventh year of the program, reductions in all categories exceeded the 1997 reduction goals. (For more details see the ***Environmental Compliance Summary: Calendar Year 1997*** [p.xlvii].)

Pollution Prevention Awareness Program

The WVDP's pollution prevention awareness program is a significant part of the Project's overall waste minimization program. The program includes hazard communication training and new-employee orientation that provides information about the WVDP's Industrial Hygiene and Safety Manual, environmental pollution control procedures, and the Hazardous Waste Management Plan. The WVDP also has expanded its recycling program to include glass and plastic food containers, scrap wood, and scrap metal. The WVDP's goal is to make all employees aware of the importance of pollution prevention both at work and at home.

In conjunction with Earth Day, employees made presentations to more than 1,200 students at eleven local schools about the benefits of reducing, recycling, and reusing.

Waste Management

Significant achievements in 1997 included overall strategy and long-range waste management program planning; waste storage, processing, and off-site disposal; compliance with regulatory requirements; waste volume reduction; and waste minimization and pollution prevention:

- The WVDP Site Technology Coordination group continued to help identify and implement new waste management technologies for WVDP wastes. This group is charged with identifying technology required to meet existing and future waste management goals, evaluating emerging technologies, and promoting technology transfer between DOE facilities, federal agencies, and private industry.

- 712 drums (55-gal) of low-level waste were repackaged for off-site shipment and volume reduction. Approximately 5,000 ft^3 of low-level waste was shipped off-site for commercial treatment and disposal. The volume of low-level waste was reduced by about 20,000 ft^3 through restructuring storage facilities, sorting, soil sorting, and consolidating existing low-level waste inventories.

- Spent synthetic ion-exchange resins were determined to be Class A radioactive waste and were dewatered. Resins will be stored and shipped in 122 ft^3 B-25 overpack steel boxes.

- The CO_2 decontamination demonstration was successfully completed, achieving free release criteria for 16,000 pounds of decontaminated lead. Further decontamination of scrap metal using CO_2 blasting was deemed uneconomical.

- Soil sorting using a mechanical sorting unit as a demonstration project processed more than 19,000 ft^3 of contaminated soils and successfully released more than 9,900 ft^3 of soil with radiological concentrations lower than the criteria limit of 25 pCi/g. This resulted in an overall volume reduction of 51.3%.

- Several low-dose containers were inspected and radiologically screened for possible removal of nonradiologically contaminated materials. Non-radiological materials were removed, shredded, and disposed of as industrial waste, resulting in a net volume reduction of 170 ft^3.

- In accordance with the Site Treatment Plan developed under the Federal Facility Compliance Act, which describes treatment capacities and technologies, all calendar year 1997 milestones for the characterization, treatment, and disposition of radioactive mixed waste at the WVDP were completed.

National Environmental Policy Act Activities

Under the National Environmental Policy Act (NEPA), the Department of Energy is required to consider the overall environmental effects of its proposed actions or federal projects. The President's Council on Environmental Quality established a screening system of analyses and documentation that requires each proposed action to be categorized according to the extent of its potential environmental effect. The levels of documentation include categorical exclusions (CXs), environmental assessments (EAs), and environmental impact statements (EISs).

Categorical exclusions evaluate and document actions that will not have a significant effect on the environment. Environmental assessments evaluate the extent to which the proposed action will affect the environment. If a proposed action has the potential for significant effects, an environmental impact statement is prepared that describes proposed alternatives to an action and explains the effects.

NEPA activities at the WVDP involve facility maintenance and minor projects that support high-level waste vitrification. These projects are documented and submitted for approval as categorical exclusions, although environmental assessments are occasionally necessary.

In December 1988 the DOE published a Notice of Intent to prepare an environmental impact statement for the completion of the WVDP and closure of the facilities at the WNYNSC. The environmental impact statement describes the potential environmental effects associated with Project completion and various site closure alternatives. The draft environmental impact statement was completed in 1996 and released for a six-month public review and comment period. Comments currently are being evaluated. Having met throughout 1997 to review alternatives presented in the environmental impact statement, the Citizen Task Force will prepare recommendations during 1998 to aid the WVDP in selecting a preferred alternative. (See the ***Environmental Compliance Summary: Calendar Year 1997*** [p.lviii] for a more detailed discussion of specific NEPA activities in 1997.)

A supplement to the draft environmental impact statement is scheduled for release in August 1999, with a final version of the EIS expected in April 2000. The Record of Decision is scheduled for May 2000.

In addition to the public comment process required by the National Environmental Policy Act, NYSERDA, with participation from the DOE, formed a Citizen Task Force in January 1997. The mission of the Task Force is to assist in the development of a preferred alternative for the completion of the West Valley Demonstration Project and the cleanup, closure, or long-term management of the facilities at the Western New York Nuclear Service Center. The Task Force process has helped illuminate the various interests and concerns of the community, increased the two-way flow of information between the site managers and the community, and provided an effective way for the Task Force members to establish a mutually agreed upon set of recommendations for the site managers to consider in their decision-making process.

Self-Assessments

Self-assessments continued to be conducted in 1997 to review the management and effectiveness of the WVDP environmental protection and monitoring programs. Results of these self-assessments are evaluated and corrective actions are tracked through completion. Overall results of these self-assessments found that the WVDP continued to implement and in some cases improve the quality of the environmental protection and monitoring program. (See the ***Environmental Compliance Summary: Calendar Year 1997*** [p. lxi] and ***Chapter 5, Quality Assurance*** [p. 5-6].)

Occupational Safety and Environmental Training

The occupational safety of personnel who are involved in industrial operations is protected by standards promulgated under the Occupational Safety and Health Act (OSHA). This act governs diverse occupational hazards ranging from electrical safety and protection from fire to the handling of hazardous materials. The purpose of OSHA is to maintain a safe and healthy working environment for employees.

Hazardous Waste Operations and Emergency Response regulations require that employees at treatment, storage, and disposal facilities, who may be exposed to health and safety hazards during hazardous waste operations, receive training appropriate to their job function and responsibilities. The WVDP Environmental, Health, and Safety training matrix identifies the specific training requirements for affected employees.

The WVDP provides the standard twenty-four-hour hazardous waste operations and emergency response training. (Emergency response training includes spill response measures and controlling contamination of groundwater.) Training programs also contain information on waste minimization, pollution prevention, and the WVDP environmental management program. Besides this standard training, employees working in radiological areas receive additional training on subjects such as understanding radiation and radiation warning signs, dosimetry, and respiratory protection. In addition, qualification standards for specific job functions at the site are required and maintained. These programs have evolved into a comprehensive curriculum of knowledge and skills necessary to maintain the health and safety of employees and ensure the continued compliance of the WVDP.

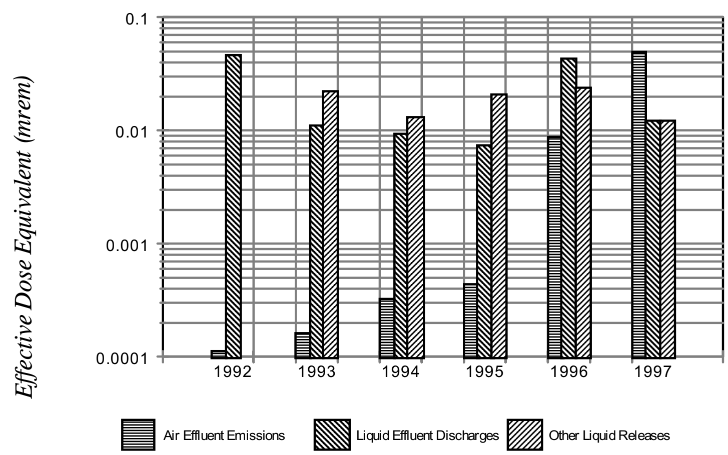

Figure 1-1. Annual Effective Dose Equivalent to the Maximally Exposed Off-site Individual

The WVDP maintains a hazardous materials response team that is trained to respond to spills of hazardous materials. This team maintains its proficiency through classroom instruction and scheduled training drills.

Medical emergencies on-site are handled by the WVDP Emergency Medical Response Team. This team consists of on-site professional medical staff, volunteer New York State-certified emergency medical technicians, and main plant operators who are certified as New York State First Responders.

Any person working at the WVDP who has a picture badge receives general employee training covering health and safety, emergency response, and environmental compliance issues. All visitors to the WVDP also receive a site-specific briefing on safety and emergency procedures before being admitted to the site.

Performance Measures

Performance measures can be used to evaluate effectiveness, efficiency, quality, timeliness, productivity, safety, or other areas that reflect achievements related to an organization's or process' goals. Performance measures can be used as a tool to identify the need to institute changes.

Several performance measures applicable to operations conducted at the WVDP are discussed below. These measures reflect process performance related to wastewater treatment in the low-level liquid waste treatment facility, the identification of spills and releases, the reduction in the generation of wastes, the potential radiological dose received by the maximally exposed off-site individual, and the transfer of high-level waste to the vitrification system.

Radiation Doses to the Maximally Exposed Off-Site Individual

One of the most important pieces of information derived from environmental monitoring program data is the potential radiological dose to an off-site individual from on-site activities. As an overall assessment of Project activities and the effectiveness

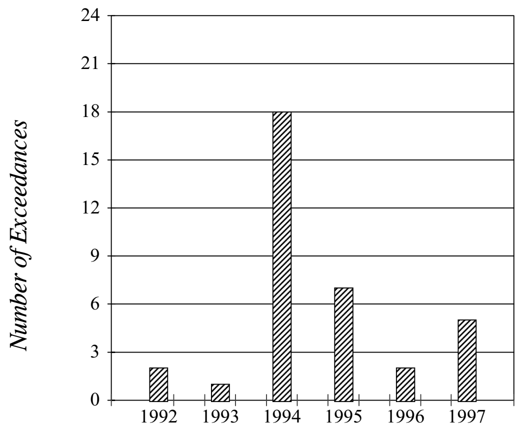

Figure 1-2. SPDES Permit Exceedances by Year

of the as-low-as-reasonably achievable (ALARA) concept, the effective radiological dose to the maximally exposed off-site individual provides an indicator of well-managed radiological operations. The effective dose equivalent for air effluent emissions, liquid effluent discharges, and other liquid releases (such as swamp drainage) from 1992 through 1997 are graphed in Figure 1-1 (p. 1-13). Note that the sum of these values is well below the DOE standard of 100 mrem. These consistently low results indicate that radiological activities at the site are well-controlled. (See also Table 4-2 [p.4-7] in ***Chapter 4, Radiological Dose Assessments***.)

SPDES Permit Limit Exceedances

Effective operation of the site wastewater treatment facilities is indicated by compliance with the applicable discharge permit limitations. Approximately sixty parameters are monitored regularly as part of the SPDES permit requirements. The analytical results are reported to the state via Discharge Monitoring Reports required under the SPDES program. The goal of LLWTF and wastewater treatment facility (WWTF) operations is to operate those facilities such that effluent water quality is consistently within the permit requirements.

SPDES permit limit exceedances do occur periodically. A graph of the number of SPDES permit limit exceedances occurring in each calendar year from 1992 through 1997 is shown in Figure 1-2 (this page). Although exceedances are not always related to operating deficiencies, they still can indicate the need to institute changes. All SPDES permit limit exceedances are evaluated to determine their cause and to identify potential corrective measures, including improved operation or treatment techniques.

Waste Minimization and Pollution Prevention

The WVDP has initiated a program to reduce the quantities of waste generated from site activities. Reductions in the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial wastes, and sanitary wastes such as paper, glass, plastic, wood, and scrap metal were targeted. To demonstrate the effectiveness of the waste minimization program, a graph of the percentage of waste reduction achieved above the annual goal for each category is presented in Figure 1-3 (p.1-15) for calendar years 1992 through 1997. Not all waste streams have been tracked over this period. Note that the low-level radioactive waste figures from 1993 through 1995 include the volume of drummed waste produced in the cement solidification system. The hazardous waste quantity for 1994 also includes about 1,900 kilograms (4,200 lbs) of waste produced in preparing for vitrification. Hazardous waste and industrial waste volumes have been tracked separately for vitrification-related and nonvitrification-related waste streams since vitrification began in 1996. To maintain historical comparability, the percentages in Figure 1-3 include only the nonvitrification portions of these two waste streams.

Spills and Releases

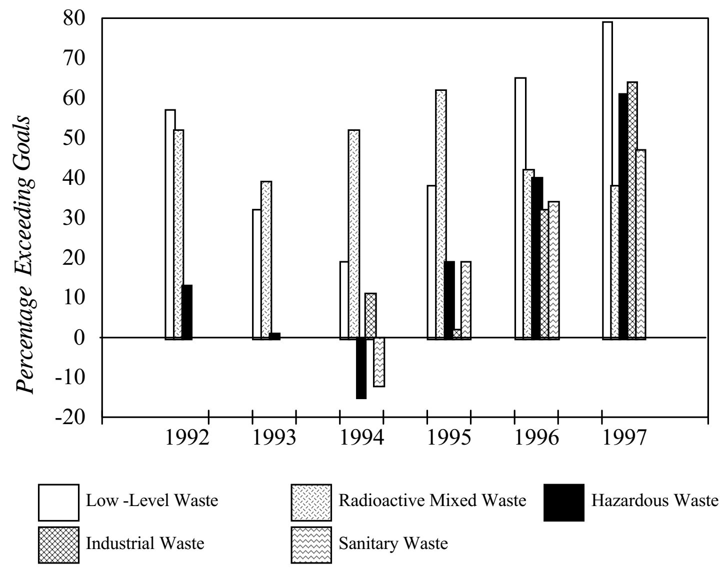

Figure 1-3. Waste Reduction Percentage Exceeding Goals

Chemical spills greater than the applicable reportable quantity must be reported immediately to NYSDEC and the National Response Center and other agencies as required. Petroleum spills greater than 5 gallons must be reported within two hours to NYSDEC. Spills of any amount that travel to waters of the state must be reported immediately to the NYSDEC spill hotline and entered in the monthly log. There were no spills of diesel fuel immediately reportable to NYSDEC in 1997. However, petroleum-contaminated soils were discovered during excavation of an underground tank that had been used to store gasoline. It is presumed that the leak occurred before the tank was decommissioned in 1985. (See the ***Environmental Compliance Summary: Calendar Year 1997***, p. lvi). Figure 1-4 (this page) is a bar graph of immediately reportable spills from 1992 to 1997.

Prevention is the best means of protection against oil, chemical, and hazardous substance spills or releases. WVDP employees are trained in applicable standard operating procedures for equipment that they use, and best management practices have been developed that identify potential spill sources and present measures to reduce the potential for releases to occur. Spill training, notification, and reporting policies have also been developed to emphasize the responsibility of each employee to report spills immediately upon discovery. This first-line reporting helps to ensure that spills will be properly documented and mitigated in accordance with applicable regulations.

Vitrification

The primary objective of the West Valley Demonstration Project is to safely solidify the high-level radioactive waste at the site in borosilicate glass. To do this, the high-level waste sludge is transferred in batches from the tank where it currently is stored to the vitrification facility. After transfer, the waste is solidified into a durable glass for safe storage and future transport to a federal reposi-

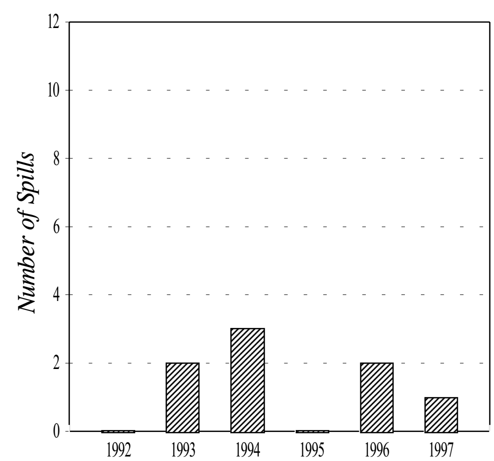

Figure 1-4. Number of Immediately Reportable Spills and Releases

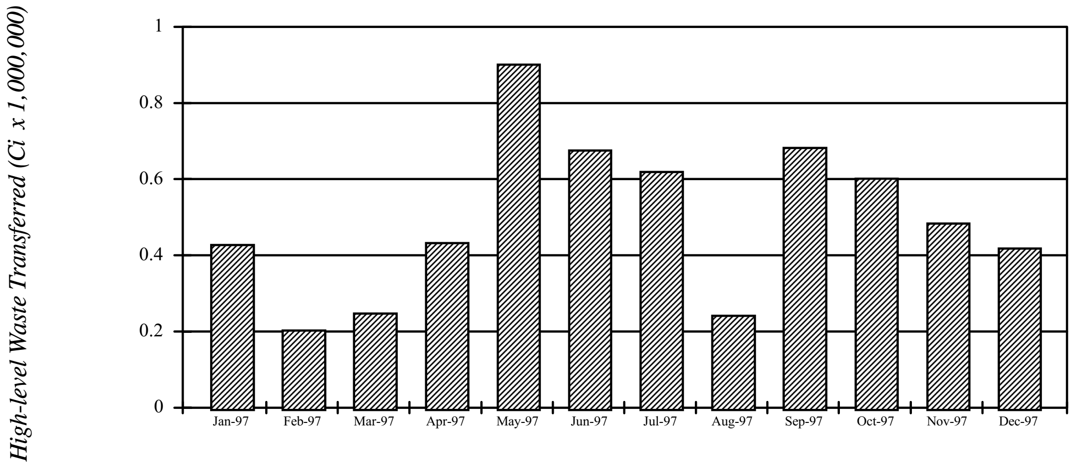

Figure 1-5. Number of Curies Transferred per Month to the Vitrification Facility

tory. It is estimated that 12 million curies of strontium and cesium radioactivity in the high-level waste eventually will be vitrified. (Radioactive cesium and strontium isotopes account for 98% of the long-lived radioactivity.) To quantify the progress made toward completing the vitrification goal, Figure 1-5 (above) shows the number of curies transferred per month to the vitrification facility in 1997.